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The relation between memorization and
certain aids and hindrances in learning

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THE RELATION BETWEEN MEMORIZATION AND
CERTAIN AIDS AND HINDRANCES IN LEARNING

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A. B. University of Illinois, 1909

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THESIS

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Vere Dorothy Perring

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and Certain Aids and Hindrances in Learning*

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I A I M O F P R O B L E M

In this problem our aim has been to determine the relation between memorization and certain aids and hindrances in learning. We have attempted to make this determination under actual school conditions. The attempt has been to preserve as far as possible the exact technique of the psychological laboratory and at the same time to make the experiment closely resemble the ordinary activities of the school room. In this we were reasonably successful. We made this a study of individuals. We graded each pupil, watched closely the effect of each test series on each one and figured not only average, but individual per cents. From these figures we deducted our general conclusions.

II P R E V I O U S L I T E R A T U R E R E L A T E D T O T H E P R O B L E M

Lay, Fuchs, Haggennüller and Itschner^{*} have investigated this particular problem, probably more thoroughly and with better results than any other investigators. They did not confine themselves to visual presentation alone but took also the auditory methods of presentation. They compared the two methods of presentation and attempted to determine the influence of excluding vocalization in different degrees in both visual and auditory presentation and the

^{*} For review of this literature see the Psychological Review Monograph No. 44 Nov. 1909.

influence of writing the word simultaneously with its visual presentation. Excluding the auditory presentation we find these investigators were dealing with practically the same problem as the one we have taken up the past year. They made their investigations on school children in the different grades. Lay and Itschner used nonsense syllables for material, Fuchs and Haggenmüller used unfamiliar German and Latin words. Lay and Fuchs and Haggenmüller kept the number of repetitions of the material constant and varied the presentation time. Itschner kept the presentation time constant and varied the number of repetitions. We kept both the presentation time and the number of repetitions the same for all series of our visual presentation. They had the children pronounce the words aloud as well as whisper them. We took only the series in which we had them whisper. Summing up their methods of presenting the material we have the following table:

Visual Presentation

- (a) Seen, without vocalization by pupils.
- (b) Seen, words pronounced in a whisper.
- (c) Seen, words pronounced aloud.
- (d) Seen, letters pronounced aloud.
- (e) Seen, copied simultaneously by pupils.

The method of excluding vocalization was that of requesting the pupils to hold the tongue between the teeth while the words were presented.

The following tabulation shows their results. The figures being average number of errors in recall per pupil per group of words.

	Lay	Fuchs and Haggenmüller	Itschner	Average
a	1.22	.84	1.40	1.15
b	1.02	.73	1.70	1.15
c	.95	.76	1.47	.72
d	1.59	.58	2.10	1.42
e	.54	.37	1.62	.84

These figures do not seem very conclusive. Itschner's results for example seem to show that the number of errors are greater when the children whisper or repeat them aloud, than they are when they hold the tongue between the teeth. Itschner concedes the fact that Lay's results are more nearly correct for the latter's experiment was more extensive than his own.

There are a good many criticisms that might be made of this experiment. In the first place, repeating the words aloud would in all probability prove a distraction for it would tend to be abnormal. Few children in memorizing

are permitted to speak aloud, while often in the classroom they whisper their lessons softly to themselves. So many talking aloud would surely create confusion and prove a distraction. Then in the case of writing simultaneously, they have no series in which the children held their hands, with which to compare this. One explanation of the slight per cent of errors in the case of the exclusion of vocalization, may be that this was not entirely excluded. Then, as suggested before, there is no common basis or number of repetitions, on which to compare these various investigators.

III PRELIMINARY EXPERIMENTS.

In the college year 1908-'09 we performed some preliminary experiments concerning the value of motor processes in memorizing in the case of school children in the various grades. We tried two methods of visual presentation of nonsense syllables, namely, that of simultaneous and successive presentation. We presented a series of eight syllables three times. In the case of simultaneous presentation we allowed the children to study the syllables for twenty-four seconds, then covered them for twenty seconds; after three study periods of twenty-four seconds each we gave them one minute in which to write all they could recall of the eight syllables. In the case of successive presentation we exposed each syllable three seconds, and so on through the series of eight syllables, it taking a total of twenty-four seconds for each study period and a rest interval of twenty

seconds between each period, the same as in the simultaneous presentation. This we also repeated three times and then gave them one minute to recall. A series in which we gave the children no instructions as to what they were to do while studying the material, we called a normal series. The following week we had the different grades write on their desks with the blunt end of their pencil the syllable as soon as seen. Another week we told them to whisper the syllables. Another to hold the tongue between the teeth and still another to fold their hands. These we termed test series. We gave first a normal, then two test series, then another normal, and so on until we had three normal and four test series. We graded the papers each time and tabulated our results. In the case of simultaneous presentation, the general results were as follows: The grades show the average per cent of correctness in the different series of all pupils.

Grade	Normal	Hands	Write	Normal	Whis- per	Tongue	Normal	Average Normal
4	46	53	48	57	64	54	62	55
5	62	48	59	61	66	56	62	61
6	77	62	65	65	72	67	76	62
7	68	69	75	73	79	66	83	74
8	80	79	87	83	82	80	89	84

In the case of the successive presentation the results were as follows:

Grade	Normal	Write	Hands	Normal	Whisper	Tongue	Normal	Average
4	60	60	69	75	88	82	88	74
5	57	61	63	70	89	85	87	71
6	50	63	67	56	64	70	71	59
7	62	68	75	74	70	79	80	72
8	60	87	87	75	75	75	88	78

There are a great many faults to be found with this experiment. We gave only three preliminary tests before we began the experiment proper. In this way we did not eliminate the practice effects. Then we gave only three normal series, having the test series in groups of two. This way we had no average normal with which to compare each test series. Furthermore we had too many individuals in each grade. There averaged from 35 to 40. It was almost impossible to watch them all to see that each one did as directed. For example, one child who failed to hold his tongue between his teeth, might destroy the value of the entire test, unless we noticed his failure and threw away his paper. Then in both experiments we were rather unfortunate in having certain observers who became rather antagonistic toward the experiment as it

progressed. Their attention decreased and it required a great deal of effort to make them keep up to the standard. We did not adopt the plan then of reporting to them the grades they made on each test. The test cards were not of the best, for the lettering was rather small and sufficient care had not been taken to eliminate all suggestive syllables. For example in one series the syllable "yip" occurred, and caused a great deal of merriment. The latter was then a distraction, for although practically every pupil recalled the syllable "yip", yet the entire number of syllables they recalled was less than usual. Aside from the fact that some syllables were more suggestive than others, was the fact that they were not all of equal difficulty. Some could be pronounced and some could not. Knowing all these things, we attempted in the investigation this year to profit by our past experience, overcome all previous difficulties and obtain results which would be conclusive.

IV EXPERIMENT OF 1909-1910

This year we confined ourselves to one school and one method of exposure, - Visual Simultaneous. We took children in the fourth, fifth, seventh and eighth grades. They averaged about fourteen pupils to the grade. In this way we were able to watch all very closely. We prepared our own test cards. We took nonsense syllables of three letters and placed eight syllables made of black letters on white cardboard 20 x 12 inches. We tried to make each series of

equal difficulty and to eliminate all suggestive syllables.

We devoted six weeks to giving practice series. In this way the pupils were perfectly familiar with the various methods of presentation, and knew exactly what was expected of them. As far as practice effects were concerned this six weeks course practically eliminated them. We used the same presentation time as in 1908-1909, that is a study period of twenty-four seconds for three times with a rest interval of twenty seconds between each one. Then we gave them one minute to write all the syllables they could recall.

We varied the way in which we presented the group of eight nonsense syllables. The first week after we began the experiment proper we gave each grade a normal series. The second week the fourth grade were asked to fold their hands on the desk before them, the fifth grade to whisper the syllables as they saw them, the seventh grade to hold the tongue between the teeth and the eighth to write the syllables on the desk with the blunt end of their pencils. We continued this until we had given each grade four test and five normal series. We graded the papers each time and then told the children the following week the grades they had made on the previous test. In this way we kept up the interest until the last.

We used the utmost care throughout the experiment to eliminate all factors contrary to the success of the experiment. We threw away at various times papers of an entire grade because of some slight distracting element which entered in.--For example during the presentation of one series a visitor knocked

at the door. The teacher answered it. We finished the test, but on grading the papers, found that despite the fact that it was a normal series, the majority of the pupils had fallen off from 25 to 50% of their average work. We repeated this series took care to avoid and in like manner/any other serious factors which entered in to affect in any way the validity of our results. In this manner we obtained a group of nine different series which as far as we were able to tell, were perfect.

FOURTH
GRADE

NOR: HANDS	: NOR: TONGUE:	NOR: WRITE:	NOR: WHIS	NOR
MAL: FOLD	: MAL: TEETH	: MAL: WORDS:	MAL: PER	MAL
:	:	:	:	:
:	:	:	:	:
45 : 43	: 42 : 43	: 56 : 40	: 57 : 59:	60
:	:	:	:	:
:	:	:	:	:
:	: AV :	: AV :	: AV :	AV
:	: NOR:	: NOR:	: NOR:	NOR
43	43 43	49: 40	56 1/2 59 58	1/2

PER CENTS

	1-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL PER CENT PER NOT AFFECTED	COMPARATIVE EVALUATION OF PER CENTS	
Hands) Aid				2	2	1					32%	18%	225
Fold-) Dis-													
ed) tract	1	2	1	2	2			2			50%		220
Write) Aid		1		2							16 2/3	16 2/3	85
) Dis-													
) tract	1		2	3	1	3		2			66 2/3		520
Whisper) Aid	4	3	4	2							81%		235
) Dis-													
) tract		2		1							19%		65
Tongue) Aid			2			1					20	6%	105
in) Dis-													
Teeth) tract		2	2	2	1	2		2			74		455

FIFTH	NOR :WHIS	NOR HAND	NOR WRITE	NOR TONGUE	NOR
GRADE	MAL :PER :	MAL FOLD	MAL WORD	MAL TEETH :	MAL
A	:61 :	:58 :	:54 :	:58 :	:57 :
	:62 :	:45 :	:	:	:
	:69 :	:	:	:	:
	:AV :	:	:AV :	:	:AV :
	:NOR :	:	:NOR :	:	:NOR :
	61	57	54	57	1/2 57
				60	45 65

B	PER CENTS										TOTAL PER PER CENT COMPARATIVE		
	:	:	:	:	:	:	:	:	:	:	CENT :	NOT AF-	EVALUATION
	:	:	:	:	:	:	:	:	:	:	:	PECTED	OF PER CENTS
	1-9	10-	20-	30-	40-	50-	60-	70-	80-	90-	:	:	:
	:	19:	29:	39:	49:	59:	69:	79:	89:	99:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
Hands)Aid	:	2	:	1	:	1	:	:	:	:	33 1/3	:	120
Fold-)Dis-	:	:	:	:	:	:	:	:	:	:	:	:	:
ed)tract	:	2	2	2	:	1	:	:	:	1	66 2/3	:	205
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
)Aid	:	1	:	2	:	1	:	:	:	:	40%	20%	140
Write)Dis	:	:	:	:	:	:	:	:	:	:	:	:	:
)tract	1	:	2	:	:	1	:	:	:	:	40%	:	110
)Aid	:	:	2	3	1	:	:	:	:	:	60%	10%	210
Whisper)Dis-	:	:	:	:	:	:	:	:	:	:	:	:	:
)tract	:	:	1	1	:	1	:	:	:	:	30%	:	115
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
Tongue)Aid	:	:	:	:	:	:	:	:	:	:	:	:	:
in)Dis-	:	:	:	:	:	:	:	:	:	:	:	:	:
Teeth)tract	:2	2	1	1	2	:	:	2	:	:	100%	:	340

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SEVENTH
GRADE

B

Hands) Aid
Fold) Dis-
ed) tract

											TOTAL	PER CENT	COMPARATIVE
1-	2	10-	20-	30-	40-	50-	60-	70-	80-	90-	PER	NOR AF-	EVALUATION
		19:	29:	39:	49:	59:	69:	79:	89:	99:	CENT	PECTED	OF PER CENTS
1	1	2									20 1/3	16 2/3	70
1	2	4	2	1	1						63		305
	1	5	2	1	1						55 2/3	11%	310
	1	3		1							33 1/3		140
2	4	5	2	1	2						80%		420
2	2										20%		40
2	1										17%		25
	3	4	2	1	3	1			1		83%		435

Write) Aid
) Dis-
) tract

Whisper) Aid
Dis-
tract

Tongue) Aid
in) Dis-
Teeth) tracti

AVERAGE PER CENT OF CORRECTNESS IN EIGHTH GRADE

EIGHTH GRADE	A	NOR :WRITE MAL :WORD	NOR :HAND MAL :FOLD	NOR :WHIS MAL :PER	:NOR :TONGUE :MAL :TEETH	NOR			
		78 1/2	86	72 3/4	85 1/2	86	84	66 2/3	92
		2							
			:AV	:	AV	:	:AV	:	:AV
			:NOR	:	NOR	:	:NOR	:	:NOR
		86	82	72	86	86	85	66 2/3	88

B

PER CENTS

	1-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL PER CENT	PER CENT NOT AFFECTED	COMPARATIVE EVALUATION OF PER CENT
Hands) Aid	1	2									25%	8 1/3	35
Fold-) Dis-													
ed) tract	1		5	2							66 2/3		200
) Aid	2	1	1								50	8 1/3	50
Write) Dis-													
) tract	1		3	1							41 2/3		115
) Aid	2	2	1	2							71 2/3	8 1/3	135
Whisper) Dis-													
) tract			2								20		50
Tongue) Aid	1										14 2/7	7 1/7	5
in) Dis-													
Teeth) tract	1	2	4	1	2	1					78 4/7		315

VI GENERAL SIGNIFICANCE OF RESULTS

The foregoing tables give the results in concise form. Section A in tables 1, 2, 3 and 4 represents the average per cent of correctness of all pupils in each grade for each different series. For example, in the fourth grade, in Section A, 45 % is given as per cent of correctness in the first normal series. To obtain this we took the grades that all the fourth year pupils obtained on the first normal series, added them together and obtained the average per cent of correctness.

Section B gives the individual per cents. We took the grade of each pupil and determined the per cent aided or distracted in each test series. In order to get this, we compared the grade a pupil made on a test series with the average of the two normal series, i. e., the normal given before and the normal given after the test series. For example, if a pupil had a grade of 25 on a test series and a grade of $33 \frac{1}{3}$ on normal series before it, and a grade of $66 \frac{2}{3}$ on a normal series after it, the average normal series would be 50 and comparing this with 25, (the grade received on the test series), we would find that the pupil was distracted 50 %.

Then from these individual per cents we determined the total per cent of pupils in the fourth grade aided in each test series, the total per cent distracted and the total per cent neither aided nor distracted. In like manner we obtained the per cents for fifth, seventh and eighth grades.

The last column of Section B gives the comparative evaluation of per cents. This we obtained by adding the entire number of per cents each pupil was aided or distracted. For example two were aided 35 %. This would make 70 %, two more aided 45 = 90, one aided 65. $70 + 90 + 65 = 225$.

A careful study of these tables shows a number of significant results:

(a) Distraction in Folding the Hands.

In the fourth and fifth grades we find that the distraction is slightly less than in the seventh and eighth grades. This result may be due to one or both of two causes.

(1) Distraction caused by the folding of the hands itself.

(2) The inhibition of motor aids connected with writing or other expressive movements.

In the lower grades the distraction is probably due to the first cause alone, for here the children have not reached the stage of development in which motor aids connected with writing are of any help. In the higher grades, however, the distraction is probably due to both causes, for writing has become mechanical and forms a great part in their learning processes.

(b) Hindrance Caused by Writing

In the fourth grade, the pupils seem very much distracted by writing, only $16 \frac{2}{3}$ % being aided. In the fifth grade according to the investigation of this year, we find writing has the same per cent of aid as distraction.

Last year's experiment showed writing to be more of a distraction than an aid. In Section B of the tables, in which we determined the individual per cents, we find that the higher grades were not aided as much by writing as by whispering. For example in the seventh grade the pupils were aided 80 % and distracted 20 % when they whispered the syllables, while they were only aided $55 \frac{2}{3}$ % and distracted $33 \frac{1}{3}$ % when they wrote the syllables. Last year's experiment showed the higher grades to be aided a greater per cent in writing than in whispering. This year's experiment showed just the reverse. This can probably be explained from the fact that this year we were dealing with pupils of the lower class, they were not as highly developed as those in the other schools, due largely to their environment, i.e., their parents are an uneducated class of people, and so do not help their children in any way. The only instruction the children receive is in the classroom. Naturally they are more backward. They employ their early methods of studying for a longer time. They are not able to master the art of writing so easily, their attention is fixed on how to write. It doesn't seem to be as mechanical as it was with the pupils of last year's experiment, their interest and attention, however, were better than that of last year's pupils. We conclude, on studying the results of both years, that writing plays a greater part in aiding the pupils, in memorizing, the higher they are advanced. In the lower

grades, writing does not form as great a part of their work, they do not make as great use of it as do pupils of seventh and eighth grades; they have not mechanized it sufficiently; naturally it would serve to distract rather than aid pupils of fourth and fifth grades.

(c) Aid in Whispering

The results show that whispering is a decided aid in all grades. Its value does not decrease the older the pupils are. For example fourth grade pupils are aided 81 % and seventh grade 80 %. This is a remarkable per cent. In watching the pupils during the test series, we found when we allowed them to whisper, they acted as if all restraint had been thrown off. It seemed to be a relief to them to give vent to their natural tendencies. The per cent aided by whispering as noted before, seems rather large for seventh and eighth grade, but this is probably due to the fact that as pupils advance in the grades they employ more and more, verbal-motor methods of thinking and learning, therefore whispering becomes an increasing aid.

(d) Distraction of Holding the Tongue Between the Teeth.

There is no doubt but what this is a decided distraction in all grades. (1) It is a positive distraction; (2) It inhibits motor ^{ideation} ~~speech~~. Just as the per cent aided by whispering was rather high for Eighth grade pupils, so the per cent distracted was high. In fifth grade it proved a distraction in every case and in seventh grade the per cent was as high as 83 %. The individuals that were aided show this

aid was very slight. In two cases it was only 5 %, in the other 15 %, while in the case of distraction one individual was distracted to the amount of 95 %.

(e) Evidence of Improvement Through Practice.

From the results of the normal series we see that in every grade there is a decided improvement in the normal series, as the experiment progresses. This improvement, however, is not exactly uniform. There are slight drops, but the average normals show uniform improvement. For example, in the fifth grade we find the normal series to be 56-58-58-62-69. But averaging the first and second, the second and third, etc., we get the following: 57-57 1/2-60-65--showing a steady altho not great improvement. We attribute the slight difference to the fact that we eliminated to a great extent, the element of practice, by giving so many preliminary series. One noticeable thing is that in every grade, except the seventh, there is greater improvement in the last normal series over the normal series immediately preceding it, than in any other two. This is probably due to the fact that the pupils knew it was the last series of the experiment and so put forth every effort to make it the best.

S U M M A R Y

From these results we draw the following general conclusions.

(a) Whispering or vocalization is a decided aid in all grades.

(b) Folding the hands is a distraction in all grades with the exception, in our experiment, of the fifth grade where it seems to be neither a distraction nor an aid.

(c) Holding the tongue between the teeth is a decided distraction in all grades.

(d) Writing is a distraction in the lower grades, but becomes of added importance in the higher grades, forming an aid in seventh and eighth grades.

General Pedagogical Application

We find that the amount of material the pupils are able to memorize or recall varies according to the amount they are aided or distracted when learning. Since we have found vocalization in all grades and writing in the higher grades to be of aid, it seems that greater stress should be laid upon these aids in the schools of today. It is true that whispering proves distracting to the teacher and for that reason pupils are restrained from it as much as possible. If it were possible to arrange the classes so that all pupils in a room could be studying at the same time, it would no doubt prove beneficial to allow them to whisper as they

studied their lessons.

It is a simpler matter of course to allow the pupils the opportunity of aiding themselves by writing. Many of the lessons recited could be written, thus better fixing them in the minds of the pupils. This would only hold true in the higher grades however, for pupils of the lower grades have not mechanized writing sufficiently for it to prove other than a distraction.





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